Digital Communications Analyzer 2841
2 Mbit/s Transmission Analyzer 2840A

Hand-held, high capability testing for 2 Mbit/s and data line systems and equipment

- Handheld, battery operated, data and PCM rate tester
- Framed and unframed operation at 2 Mbit/s including n x 64 kbit/s
- Data test interfaces: (2841) RS-232, X.21, V.35, RS-449 (V.36), codirectional, contradirectional
- G.821, G.826, M.2100 analysis
- Histograms for error distribution and alarms
- Print from up to 10 results stores
- Analog channel generation and measurement
- Measurements include propagation delay, output level attenuation, frequency deviation, frequency and level measurement, and CAS

GENERAL

The 2840A 2 Mbit/s Transmission Analyzer is a hand-held analyzer for installation and maintenance measurements on digital 2 Mbit/s lines and equipment. The 2841 Digital Communications Analyzer adds data interface testing to this 2 Mbit/s capability. The comprehensive measurement capability is contained in a compact, battery operated package, combined with a large graphics based LCD for ease of set up and results retrieval.

FRAMING SYSTEMS

2 Mbit/s framing systems with 30 and 31 channels, with and without CRC4, are generated and received to enable a range of tests on framing, alarms and signaling.

56 kbit/s and 64 kbit/s Channel Testing

Individual channels can be tested at 64 or 56 kbit/s, assisting in testing and fault location within digital data networks and cross connect switches.

n x 64 kbit/s Channel Testing

n × 64 kbit/s channels can be tested where they are carried within 2 Mbit/s digital signals. Full flexibility is provided with both contiguous and non-contiguous channel selection.

DATA INTERFACE TESTING (2841)

All commonly used data interfaces are available to give a comprehensive data test capability together with 2 Mbit/s testing. Thus 2 Mbit/s and data circuits and equipment can be tested in a hand-held, fully integrated test instrument. Data test interfaces provided are RS-232, X.21, V.35, RS-449 (V.36), codirectional and contradirectional.

Modes

Both synchronous and asynchronous modes as possible with a wide range of standard and user programmable data rates, so that traditional data interface testing can be addressed together with modern digital data services at 64 kbit/s, n x 64 kbit/s and other rates.

DATA MULTIPLEX TESTING (2841)

Independent transmitter and receiver enable connection to data and 2 Mbit/s interfaces simultaneously. This allows testing across a data multiplex to ensure integrity of data card to 2 Mbit/s path.

COMPREHENSIVE ERROR AND ALARM MEASUREMENTS

The 2840A and 2841 can detect simultaneously, Code, Framing, Pattern and CRC Errors. Further measurements are then made on a selected error type, including G.821, G.826, M.2100 and error distribution.

Error Distribution and Alarm Histograms

The error results and alarms are displayed in the form of a histogram with accumulation up to 7 days, and resolution up to 1 second. This provides a comprehensive record of long term measurements to assist in fault localisation. A permanent record of these results can be obtained by printing a text equivalent or a facsimile of the histograms subsequent to the test.

Full Results Printing - Print from RAM

The instrument can be programmed to Autoprint selected parameters from the full set, on event or on timed intervals.

These include errors, performance parameters, and alarms.

Alternatively up to 4000 print events per results store can be stored in memory (Print from RAM) for subsequent printing. This also removes the necessity of real time printing where subsequent analysis via a PC may prove this to be unnecessary.

G.821, G.826 and M.2100 Measurements

The usual ITU-T recommendation of G.821 for 64 kbit/s error performance measurement is applied. In addition the newer Recommendation G.826 extends measurements to 2 Mbit/s, while M.2100

MULTIPLE TEST STORAGE

Up to 8 full sets of results can be stored for later on screen analysis or printing. Again this can avoid real time printing.

RESIDUAL BIT ERROR RATE

Assessment of background error performance is useful in systems subject to degraded error performance, such as radio or satellite systems. RBER is long term mean error rate ignoring Severely Errored Seconds.

HIGH TOLERANCE TO BURST ERRORS

2840A and 2841 are particularly suited to measurements on systems subject to high error rates and burst errors, with the ability to ride through rapid fades as experienced on digital radio systems.

PROGRAMMABLE ERROR GATING

In addition to long term mean error ratio, a current error ratio is available with fixed gating periods of 1, 2, 5 or 10 seconds. Flexibility of application is thus assured, for example fade margin adjustment on digital radios.

IN-SERVICE AND OUT-OF-SERVICE MEASUREMENTS

The instrument is equally suited to installation and maintenance measurements. Interfaces are provided to enable the receiver to be connected to a number of network points at varying impedances and sensitivities. Automatic line equalization (automatic line build out, ALBO) is also provided to enable connection to signals attenuated by long sections of line.

IN-SERVICE CHANNEL ACCESS

Access is provided to receive timeslots for both analog and digital signals.

Voice Channels

Voice channels within a 2048 kbit/s signal can be monitored in-service and routed to an internal loudspeaker or a headphone socket for a first level check of analog level and quality.

Data Channels

64 kbit/s data channels can be routed to a V.11 interface for external measurement, for example connection of common channel signaling to a protocol analyzer.

Drop and Insert

Selected 64 or n x 64 kbit/s channels within an in-service 2048 kbit/s signal can be tested with minimum disruption of service to other in-traffic channels.

NETWORK EQUIPMENT TESTING

Comprehensive facilities enable the range of applications to be extended beyond digital link error performance testing to checking the functionality of various types of network equipment such as multiplexes and cross connect switches.

Multiplex Equipment

2840A and 2841 are able to simulate and detect alarm conditions associated with the various 2048 kbit/s frame structures, including full frame alignment strategy testing to G.706.

In addition the input level margin of the multiplex can be checked using the output level attenuation capability whilst frequency margin can be checked using the output frequency offset capability.

Cross Connect Switches

Cross Connect switches can be checked for switch path integrity using the 64 kbit/s channel test capability (or n × 64 kbit/s for new generation switches).

ANALOG CHANNEL MEASUREMENTS

Analog measurements are made on selected 2 Mbit/s channels including frequency response and linearity. The transmitter can generate sine waves across the full audio band with frequency and level resolution of 1 Hz and 0.1 dB respectively. Measurements are made of peak code, RMS level and frequency.

PROPAGATION DELAY MEASUREMENT

Delay measurements can be made on 2048 kbit/s digital circuits to a high level of accuracy. This is particularly important on satellite links where high values of delay are experienced and need to be measured, or for characterising networks to assist in finding unwanted loopbacks.

Where data circuits are extended from 2048 kbit/s bearers out to subscribers, the overall network to subscriber loop delay can be measured at 64 or n x 64 kbit/s from within the 2048 kbit/s signal.

CHANNEL ASSOCIATED SIGNALING

The 4 bit word associated with a selected channel can be controlled on the transmitter. On the receiver all 30 channels can be monitored simultaneously. In addition for a selected channel the last 16 signaling word changes can be stored for later analysis.

DIGITAL SIGNAL LEVEL AND FREQUENCY MEASUREMENT

The frequency and amplitude of the incoming digital signal are displayed to enable early warning of degradation of the signal, or to check the loss of in-station cabling to ensure it conforms to limits.

BIT SLIP DETECTION

Single, uncontrolled bit slips can be detected within framed or unframed test patterns. This allows inter and intra network clocking problems to be isolated.

OCTET SLIP DETECTION

Octet slips can be detected at the 64 kbit/s channel level of a 2048 kbit/s signal, which allows the effects of frame slips introduced by network buffers to be assessed.

EASE OF USE

The instrument is set up quickly and easily using graphics based menu selection on a large LCD, with key pad and soft keys. Commonly used instrument configurations can be stored in memory further ensuring ease of use.

RS-232 REMOTE OPERATION

Remote unattended operation can be accomplished via an RS-232 port, which can also be used for local printing. Keyboard functions can be duplicated via RS-232 commands enabling complete remote configuration and reporting of results.

POWER OPTIONS

Internal batteries give five hours operation when both transmitter and receiver are being used. Battery life is extended in monitoring applications where the transmitter can be switched off. Fast charge circuits coupled with an AC power adaptor enable recharge in only three hours.

For extended operation the AC power adaptor can be used with the batteries as standby in the event of power failure.

Specification

2 Mbit/s Transmit Interface

FRAMING AND BIT RATES
Signals can be transmitted unframed or with the frame structure indicated.
2048 kbit/s - G.704
2048 kbit/s - G.704 no multiframe
2048 kbit/s - G.704 with CRC
2048 kbit/s - G.704 with CRC, no multiframe
2048 kbit/s - 32 frame multiframe (Option 02, French)

CLOCK SOURCE
Internal, external or derived from the received signal

Internal
Accuracy
±1 ppm from 0° C to 55° C
±1 ppm / year
Frequency Offset
Small
Steps of ±5 and ±50 ppm to ±150 ppm
Large
Steps of ±2 and ±10 kbit/s to ±30 kbit/s

External
TTL
Sine wave
G.703 Figure 21

LINE CODES
AMI (50% duty cycle)
HDB3

TEST PATTERNS

Insertion
Single Channel
Selected 56 kbit/s or 64 kbit/s channel of framed signal
Channel Broadcast
All 56 kbit/s or 64 kbit/s channels of framed signal
n × 64 kbit/s Channel
Selected n × 56 kbit/s or n × 64 kbit/s channels of framed signal
Channel distribution can be contiguous or non-contiguous

Unframed
Unframed signal

PRBS
2^{6}-1
2^{9}-1
2^{11}-1
2^{15}-1
2^{20}-1
2^{23}-1

Sense
True or Inverted

Mode (framed only)

8 bit	PRBS data fills all 8 bits in an octet, ie 64 kbit/s per channel
7 + 1 bit	First 7 bits are PRBS and last bit is a 1, ie 56 kbit/s per channel

32 bit word
User programmable sequence of 32 bits
(16 bit word for Option 02, French)

Variable Sine Wave
(option 04 on 2840A)

Frequency Range	1 to 3999 Hz
Resolution	1 Hz
Level	+3 to -55 dBm0
Resolution	0.1 dB maximum.
Coding	A-Law

FILL PATTERNS
For 64 or n × 64 kbit/s operation the following patterns are used to fill all other channels

PRBS
2^{15}-1

8 bit word
User programmable sequence of 8 bits

DROP & INSERT
For framed operation the received signal is looped to the transmitter
Note that for CRC frame structures the CRC is recalculated before transmission

56 kbit/s or 64 kbit/s
A selected 56 kbit/s or 64 kbit/s channel is replaced by a test pattern.
n × 56 kbit/s or n × 64 kbit/s
A selected n × 56 kbit/s or n × 64 kbit/s channel is replaced by a test pattern. The channel selection can be contiguous or non-contiguous.

REGENERATOR LINE CURRENT LOOPTHROUGH
Line current on balanced lines can be looped through from receiver to transmitter of the instrument.

ERROR INJECTION

Target
Test Pattern Only
Framing Only
CRC Only
All

Error Type
Binary
Bits are inverted before coding.
Code
Code errors are injected by changing ±1 to 0 and 0 to ±1 where the polarity of the inserted mark is the same as the polarity of the last mark transmitted.

Injection Mode
Singly
By keypress
Fixed rate
Rate M x 10^{-N}, where M is 1 to 9 and N is 2 to 7

MAIN OUTPUTS

Balanced

Impedance	120 Ω
Peak Voltage	3 V ±0.3 V
Space Voltage	0 V ±0.3 V

Unbalanced

Impedance	75 Ω
Peak Voltage	2.37 V ± 0.237 V
Space Voltage	0V ± 0.237 V

Output Level Attenuation

Attenuation	6 and 10 dB
Accuracy	±0.5 dB

SIGNALING BIT CONTROL
For framing systems with Channel Associated Signaling capability the signaling bits can be changed.

Selected Channel	Set 4 bit word.
All Other Channels	Set 4 bit word.

C-BIT FRAMING
(Option 02, French)
Generation of C-Bit Frame for French TRANSMIC-2G System.
Control of C-Bit Frame message bits.

FRAMING TESTS
The following tests are available, depending on the framing system selected:

Frame alignment strategy
Set x in 4 consecutive frame words in error, single shot or continuously
Set x in 3 consecutive frame bits in error, single shot or continuously
Set x in 4 consecutive CRC multiframe words in error, single shot or continuously
Set x in 1000 CRC blocks in error continuously (default value is 915).

Signaling multiframe alignment strategy.
Set x in 2 consecutive multiframe words in error, single shot or continuously

Time Slot 16 (Signaling).
Set to AIS (All 1s).
Set to All 0s.

ACCESS TO STRUCTURE BITS
Change unassigned, distant, distant multiframe and alarm bits.

2 Mbit/s Receive Interface

FRAMING AND BIT RATES
Signals can be received unframed or with the frame structure indicated.
As Transmitter.

Frequency Tolerance
2048 kbit/s
±50 ppm

LINE CODES
As Transmitter.
Indication of HDB3 signal present

AUTOCONFIGURE
The receiver can be set to autoconfigure to:
2 Mbit/s framed test pattern or unframed test pattern.
64 kbit/s channel test pattern (channel search or known channel).
n × 64 kbit/s channel test pattern (known channel).

INPUT MODES AND SENSITIVITY

Modes

Terminated	Terminates the line.
Bridging	Taps onto a terminated line or unprotected monitor point.
Monitoring	Connects to a protected monitor point.

BALANCED

	Terminated	*Bridging*	*Monitor*
Impedance	120 Ω	>1000 Ω	120 Ω (3000 Ω)
Normal	3 V +2 to -6 dB	3 V +2 to -6 dB	3 V -15 to -36 dB
ALBO	3 V +2 to -30 dB		

UNBALANCED

	Terminated	*Bridging*	*Monitor*
Impedance	75 Ω	>1000 Ω	75 Ω (2400 Ω)
Normal	2.37 V +2 to -6 dB	2.37 V +2 to -6 dB	2.37 V -15 to -36 dB
ALBO	2.37 V +2 to -30 dB		

TEST PATTERNS:

Source
Selected single, contiguous, non-contiguous channels of framed signal.
Unframed signal.

PRBS
2^{6}-1
2^{9}-1
2^{11}-1
2^{15}-1
2^{20}-1
2^{23}-1

Sense
True or Inverted

Mode (framed only)
8 bit PRBS data fills all 8 bits in an octet, ie 64 kbit/s per channel
7 + 1 bit First 7 bits are PRBS and last bit is a 1, ie 56 kbit/s per channel

Repetitive Word
Any word which repeats over a 32 bit sequence. (16 bit sequence for Option 02, French)

PATTERN SYNCHRONIZATION

Loss Criterion
PRBS error rate greater than 1 in 5 for each of 10 consecutive desciseconds.

CHANNEL EXTRACT
For framed single channel operation a selected 64 kbit/s channel is extracted from the received signal:
Channel selection by increment and decrement keys
Voice frequency signals are routed to the internal loudspeaker, audio output socket, or headphone socket.
64 kbit/s data signals are output via a V.11 socket.

AUDIO CHANNEL MEASUREMENT
(option 04 on 2840A)
Frequency, Level, Peak code

Frequency	
Range	1 to 3999 Hz
Resolution	1 Hz
RMS Level	
Range	+6 to -60 dBm0
Resolution	0.1 dB maximum
Peak code	Positive and negative values are displayed.
Decoding	A-Law

VOICE FREQUENCY OUTPUT
(opt 04 on 2840A)

Range	0.3 to 3400 Hz
Decoding	A-Law
Impedance	600 Ω balanced

STATUS INDICATORS
LEDs indicate frame structure alarm conditions

Display modes
CURRENT ALARMS
Red LEDs illuminate to indicate alarm presence and extinguish when the condition clears. LEDs respond to alarm conditions with a resolution of one second.
HISTORY
When ALARM HISTORY is pressed the CURRENT ALARM LEDs indicate alarms which have illuminated since the last time the history reset button was pressed. RESET resets the ALARM HISTORY.
SIGNAL GOOD
Green LED illuminates to show absence of combination of LINE, AIS, FRAME, MF, CRC and PATTERN alarms.
LINE
Red LED ON indicates signal loss.
AIS
Red LED ON indicates signal is all 1's. All 1's is defined as signal with less than three zeros in two frame periods.
FRAME
Red LED ON indicates a loss of frame alignment.
CRC MF
Red LED ON indicates loss of CRC multiframe alignment.
CAS MF
Red LED ON indicates loss of signaling multiframe alignment.
DISTANT
Red LED ON indicates DISTANT alarm.
DMR
Red LED ON indicates Distant Multiframe Alarm.
PATTERN
Red LED ON indicates loss of pattern synchronisation.
ERROR RATE
Red LED ON indicates that the error rate of the major error type is greater than a threshold set by the user. Threshold is 1 x 10^{-N} where N is 2 to 9.
ERRORS
Red LED ON indicates major errors detected.

Additional Display Indicators
(Auxiliary Alarms Page)

HDB3 SIGNAL	Present or Not Present
TS16 AIS	Present or Not Present

UNASSIGNED FRAMING BITS
The state of the unassigned bits is displayed.

Data Test Interfaces (2841)

X.21, RS-449 (V.36), V.35, RS-232, Co/Contradirectional and TTL

X.21, RS-449 (V.36), V.35, RS-232 and Co/Contradirectional
X.21 (V.11), RS-449 (V.11), V.35, RS-232 and Co/Contradirectional are presented to a common connector. DTE/DCE interfaces are provided by adaptor cables which provide the appropriate connector and electrical interface. The DTE/DCE switching is internal.

Universal Connector
68 way type PCR female.

Adaptor Cable Connectors
X.21
15 way D-Type, ISO 4903 female.
RS-449 (V.36)
37 way D-Type, ISO 4902 female.
V.35
34 way MRAC, ISO 2593 female.
RS-232
25 way D-Type, ISO 2110 female.
Co/Contradirectional
15 way D-Type, ISO 4903 female.
Codirectional
CF x 2 female.

Cable recognition
Automatic recognition of the cable type plugged in.

TTL

Code	NRZ
Connector	Miscellaneous 25 way D-Type

CONTROL LINES

X.21

DTE	***DCE***	
I (Indication)	C (Control)	Displayed as 1, 0.
C (Control)	I (Indication)	Settable to 1, 0

RS-449 (V.36)

DTE	***DCE***	
CS (Clear to send)	RS (Request to send)	Displayed as 1, 0
RS (Request to send)	CS (Clear to send)	Settable to 1, 0
DTR (Data terminal ready)	DSR (Data set ready)	Settable to 1, 0
DSR (Data set ready)	DTR (Data terminal ready)	Displayed as 1, 0.
	DCD (Data Carrier Detect)	Settable to 1, 0.
DCD (Data Carrier Detect)		Displayed as 1, 0.

V.35

DTE	***DCE***	
CS (Clear to send)	RS (Request to send)	Displayed as 1, 0.
RS (Request to send)	CS (Clear to send)	Settable to 1, 0
DTR (Data terminal ready)	DSR (Data set ready)	Settable to 1, 0.
DSR (Data set ready)	DTR (Data terminal ready)	Displayed as 1, 0.
	DCD (Data Carrier Detect)	Settable to 1, 0.
DCD (Data Carrier Detect)		Displayed as 1, 0.

RS-232

DTE	***DCE***	
CTS (Clear to send)	RTS (Request to send)	Displayed as 1, 0.
DSR (Data set ready)	DTR (Data terminal ready)	Displayed as 1, 0.
RLSD (Receive line signal detect)	LL (Local loop)	Displayed as 1, 0.
TM (Test mode)	RL (Remote loop)	Displayed as 1, 0.
RTS (Request to send)	CTS (Clear to send)	Settable to 1, 0
DTR (Data terminal ready)	DSR (Data set ready)	Settable to 1, 0
	RLSD (Receive line signal detect)	Settable to 1, 0.
	TM (Test mode)	Settable to 1, 0.
LL (Local loop)		Set to 1 for V.54 loop 3 selected Set to 0 for V.54 loop 3 deselected
RL (Remote loop)		Set to 1 for V.54 loop 2 selected Set to 0 for V.54 loop 2 deselected

MODE
Synchronous
X.21, RS-449 (V.36), V.35, RS-232, TTL
Asynchronous
RS-449 (V.36), RS-232

IMPLEMENTATION

X.21, RS-449 (V.36), V.35, RS-232
DTE.
DCE.

Electrical
X.21
V.11 (balanced)
RS-449 (V.36)
V.11 (balanced)
V.35
V.35 (data and timing)
V.28 (control lines)
RS-232
V.28

Input Impedance
X.21, RS-449 (V.36)
V.11 Terminated
120 Ω
V.11 Unterminated
>3000 Ω
V.35
100 Ω

Data Rate
X.21, RS-449 (V.11) (Sync)
50 bit/s to 2.5 Mbit/s
V.35 (Sync)
50 bit/s to 2.5 Mbit/s.
RS-232 (Sync)
50 bits/ to 80 kbit/s
RS-232, RS-449 (Async)
50 bit/s to 38.4 kbit/s
TTL
50 bit/s to 2.5 Mbit/s

Timing
Synchronous
Transmit - DTE
From DCE
DCE input timing.
Internal
1 bit/s steps.
Receiver
Receiver clock (assumes receiver is data interface, not 2048 kbit/s, and same rate as transmitter)
External
TTL input.

Transmit - DCE
Internal
1 bit/s steps.
Receiver
Receiver clock
External
TTL input.

Receive - DTE
From DCE
DCE input timing
External
TTL input.
Signal
Extracted from receive signal

Receive - DCE
From Transmitter
Transmit clock (assumes transmitter is data interface, not 2048 kbit/s, and same rate as receiver)
External
TTL input.
Signal
Extracted from receive signal.
DTE
From DTE

Transmit - TTL
Internal
1 bit/s steps.
Receiver
Receiver clock (assumes receiver is TTL interface, not 2048 kbit/s, and same rate as transmitter).
External
TTL input.

Receive - TTL
External
TTL input.
Signal
Extracted from receive signal.
From Transmitter
Transmit clock.

Sense
All input and output timing signals can be inverted in polarity.

Asynchronous
Transmit
Internal
50, 75, 100, 110, 134.5, 200, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 14400, 19200, 38400 bit/s.
Receive
Receive signal.
Async coding
Data bits
7, 8.
Stop bits
1, 2.
Parity
Odd, even, mark, space, none.
Async character rate
Transmitter
Selectable: low medium, high, (10, 50 and 100% maximum character rate).
Receiver
Up to 1000 character/sec.

TEST PATTERNS
Sync and async

PRBS
2^{6}-1
2^{9}-1
2^{11}-1
2^{15}-1
2^{20}-1
2^{23}-1

Sense
True or inverted

Sync
32 bit word
User programmable sequence of 32 bits

Async

Fox message	3 messages to ITU-T Recommendation R.52.
Fox 1	International alphabet 2.
Fox 2	International alphabet 5, 96 character set
Fox 3	International alphabet 5, 64 character set.
User message	1 to 64 characters.

ERROR INJECTION
Singly
By keypress
Fixed rate
Rate 9×10^{-2} to 1×10^{-7} (sync only)

ALARMS
Line
Errors
Pattern
No transmit clock

PROPAGATION DELAY (sync only)
Measured using a PRBS test pattern

Range	Up to 2 seconds
Resolution	1 bit period
Update rate	Typically 2 seconds. Can be longer at low data rates.

TIMING MEASUREMENT (DTE only)
Time intervals between changes of control lines

X.21	C and I
RS-449 (V.36)	RS and CS
V.35	RTS and CTS
Range	0 to 10s
Resolution	1 ms

BIT RATE MEASUREMENT
(Transmitter and Receiver)
Measurement of transmitter bit rate confirms DCE clock rate when DTE, or external clock rate.

Sync
The bit rate is measured every second displayed to nearest 1 Hz.

Async
The character rate is measured every second displayed to nearest 1 Hz.

Accuracy
±1 ppm.

	Codirectional	*Contradirectional*
Line signal coding and level	To ITU-T Rec. G.703	To ITU-T Rec. G.703
Bit Rate	64 kbit/s	64 kbit/s
Format	Unstructured	Unstructured
Transmit Timing		
DTE	Receiver (from DCE) Internal External 2048 kbit/s	From DCE Internal Receiver External 2048 kbit/s
DCE	Internal (to DTE) External 2048 kbit/s	Internal (to DTE) External 2048 kbit/s
Receive Timing		
DTE	Extracted from receiver signal (from DCE)	Extracted from receiver signal
DCE	Extracted from receiver signal (from DTE)	Internal (to DTE) External 2048 kbit/s
Pinouts		
1, 9	Transmit Data	Transmit Data
3, 11	Receive Data	Receive Data
5, 13		Transmit Clock In (from DCE)
7, 15		Receive Clock In (from DCE)
4, 12		Transmit Clock Out (to DTE)
6, 14		Receive Clock Out (to DTE)
8	Earth	Earth

X.21 -DTE/DCE

Pins	*From DTE (To DCE)*	*Circuit*	*Pins*	*To DTE (From DCE)*	*Circuit*
2, 9	Transmit	T	4,11	Receive	R
3, 10	Control	C	6, 13	Timing	S
8	Ground		5, 12	Indication	I
			7, 14	Byte Timing	B

RS-449 (V.36) - DTE/DCE

Pins	*From DTE (To DCE)*	*Circuit*	*Pins*	*To DTE (From DCE)*	*Circuit*
4,22	SD Send Data	103	6,24	RD Receive Data	104
17,35	TT Tx Timing	113	8,26	RT Rx Timing	115
19	Signal Ground		5,23	ST Send Timing	114
7,25	RS (Request To Send)	105	9,27	CS (CTS)	106
12,30	DTR (Data Terminal Ready)	108/2	11,29	DSR (Data Set Ready)	107
			13, 31	DCD (Data Carrier Detect)	109

V.35 - DTE/DCE

Pins	*From DTE (To DCE)*	*Circuit*	*Pins*	*To DTE (From DCE)*	*Circuit*
P,S	Transmit Data	103	R,T	Receive data	104
U,W	Transmit Timing	113	V,X	Receive timing	115
B	Signal Ground		Y,AA	Transmit timing	114
C	Request to send	105	D	Clear to send	106
H	DTR (Data Terminal Ready)	108/2	E	DSR (Data Set Ready)	107
			F	DCD (Data Carrier Detect)	109

RS-232 - DTE/DCE

Pins	*From DTE (To DCE)*	*Circuit*	*Pins*	*To DTE (From DCE)*	*Circuit*
2	Transmit data	103	3	Receive data	104
24	Transmit timing	113	17	Receive timing	115
4	Request to send	105	15	Transmit timing	114
20	Data terminal ready	108	5	Clear to send	106
18	Local loop	141	6	Data set to ready	107
21	Remote loop	140	8	Receive line signal	109
7,1	Ground		25	Test mode	142

TTL (Miscellaneous connector)

Pins		*Pins*	
1	Power Feed Loopthrough A	10, 22	64 kHz clock out (V.11)
2	Power Feed Loopthrough B	11, 23	64 kHz data out (V.11)
3	Receive 2 Mbit/s or Data clock out	12, 13	Audio out (600 Ω)
4	Transmit 2 Mbit/s or Data clock out	14	Receive 2 Mbit/s or Data clock in
5	Transmit 2 Mbit/s or Data clock out	15	Transmit 2 Mbit/s or Data data in
6	Transmit external clock in	16, 17, 18	Earth
7, 19	8 kHz frame clock out (V.11)	21, 24, 25	Earth
8, 20	Octet market out (V.11)		
9	N/C		

Measurements

ERROR TYPES
Line Code (Bipolar Violations)
Frame Bit
Frame Word
Pattern
CRC
(Pattern errors only for data test interfaces)

Main parameters:
Made if the framing system and Test Mode allow.
Number of Errors.
Long Term Mean Error Ratio (LTMER).
Total Test Time.
Number of Loss of Signal (LOS) seconds.
Number of AIS seconds.
Number of No Frame Alignment seconds.
Number of No Pattern Sync seconds.
Number of No CRC Sync seconds.

OCTET SLIPS
Octet Slips are detected for single channel pattern measurements:
Number of positive and negative slips.
Time of last slip.
Time between last two slips.

BIT SLIPS
Single bit slips are detected within a 64 or n × 64 kbit/s test pattern within a 2 Mbit/s signal, an unframed 2 Mbit/s test pattern, or an unframed test pattern via one of the data test interfaces.
Positive and negative bit slips are counted.
(Bit Slips and Octet Slips are mutually exclusive).

ADDITIONAL PARAMETERS

Current Error Ratio
Gating
1, 2, 5 or 10 seconds.

Residual Bit Error ratio
(Background Error Ratio)
Long Term Mean Error Ratio excluding Severely Errored Seconds.

G.821 ERROR PERFORMANCE MEASUREMENTS
64 kbit/s channel availability measurements are made to ITU-T Recommendation G.821, while for higher rates a channel performance to G.821 Annex D is applied.

Parameters
% Available Time.
Number of Errored Seconds.
% Error Free Seconds.
Number of Severely Errored Seconds (SES).
% Non SES.
Number of Degraded Minutes (DM).
% Non DM.
Number of Breaks.
The inverse % parameters are also available.
User programmable thresholds for %ES (%Errored Seconds), %SES (%Severely Errored Seconds), %DM (%Degraded Minutes) and %US (%Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	*Limit*	*Message*
%ES	XX.XXXX	%ES > limit
%SES	XX.XXXX	%SES > limit
%DM	XX.XXXX	%DM > limit
%US	XX.XXXX	%US > limit

X=1 to 9

M.2100
Implementation of Interpretation for the Receive and Send Direction columns in Table B2/M.2100 for 2 Mbit/s signal (non CRC4) and 2 Mbit/s (CRC4).
User programmable thresholds S1 and S2 for ES (Errored Seconds), SES (Severely Errored Seconds) and US (Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	*S1 Limit*	*S2 Limit*	*Message*
ES	XXXX	XXXX	ES >S1 limit or ES > S2 limit
SES	XXXX	XXXX	SES > S1 limit or SES > S2 limit
US	XXXX	XXXX	US > S1 limit or US > S2 limit

X=1 to 9

G.826

Parameters
Number of Errored Blocks (EB).
Number of Errored Seconds (ES).
Number of Severely Errored Seconds (SES).
Number of Background Block Errors (BBE).
Errored Second Ratio (ESR).
Severely Errored Seconds Ratio (SESR).
Background Block Error Ratio (BBER).
Unavailable Seconds (US).
% Unavailable Seconds (%US).
% Available Seconds (%AS).
Number of Breaks.
User programmable thresholds for ESR (Errored Seconds Ratio), SESR (Severely Errored Second Ratio), BBER (Background Block Error Ratio) and %US (% Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	*Limit*	*Message*
ESR	X.XE-Y	ESR > limit
SESR	X.XE-Y	SESR > limit
BBER	X.XE-Y	BBER > limit
%US	X.XXXX	%US > limit

X=1 to 9, Y=2 to 8

PROPAGATION DELAY
Measured using a PRBS test pattern.

Mode
2048 kbit/s unframed.
64 kbit/s channel within 2048 kbit/s signal.
n × 64 kbit/s channel within 2048 kbit/s signal.

Range
Up to 2 seconds

Resolution
1 µs or 1 bit whichever is the greater

Update rate
Typically 2 seconds.

STORED RESULTS

Storage Capacity
Up to 4,000 events per results store including errors and alarms stored with a time and date stamp to a resolution of 1 second.

Multiple Tests
8 full sets of results stored.

Results Retrieval
Print to external printer.
Selected results histograms.
Mark portion of histogram and print selection of errors, alarms and periodic results between marks.

Error and Alarm Distribution Histograms
Any one of the following parameters can be selected as the histogram display:

Parameters
Major Errors
Errored Seconds
Severely Errored Seconds
Degraded Minutes
Unavailability
Breaks
Loss of Signal
AIS
Loss of Frame Alignment
Loss of Pattern Synchronisation

Resolution
1 second, 1 Minute, 1 Hour, 1 Day

Accumulation time
Typically 7 days or better

Histogram page width
7 or more days with a resolution of 1 day.
30 hours with a resolution of 1 hour.
30 minutes with a resolution of 1 minute.
30 seconds with a resolution of 1 second.
The display is selectable from anywhere within the N days.

Display
The stored results are displayed as a histogram. A cursor is moved to point at any day, hour, minute or second. The number of events for the parameter selected for that interval are displayed together with the date and time.

Histogram Baseline Alarms
Alarms history is shown by histogram baselines. Totals for each alarm can be determined by displaying as the main histogram with cursor scrolling and reading of alarm totals for each interval.

Alarms
Loss of signal
AIS
Loss of Frame Alignment
Loss of Pattern Synchronization
Loss of Power (not available on the main histogram)

TEST TIMING

Start time
YYYY, MM, DD, HH, MM (year, month, day, hour, minute).
By keypress

Stop time
YYYY, MM, DD, HH, MM (year, month, day, hour, minute).
By keypress.

Duration
DD, HH, MM (days, hours, minutes)
Indefinite.

SIGNALING ANALYSIS
Channel associated signaling analysis for selected channel.

Display:
Decimal and binary equivalent of current and previous
16 signaling codes.
Signaling code for all 30 channels simultaneously, with programmable IDLE and BUSY display.

C-BIT FRAMING

(Option 02, French)
Monitoring of C-Bit Frame for French TRANSMIC-2G System.
Display of C-Bit Frame message bits.

BIT RATE MEASUREMENT
The received bit rate is measured every second displayed to nearest 1 Hz.

Accuracy
±1 ppm.

DIGITAL SIGNAL VOLTAGE MEASUREMENT
The amplitude of the incoming digital signal is measured and displayed in Volts base-to-peak and dB relative to nominal.

Range
+3 to -10 dB
±1 dB
-10 to -20 dB
±2 dB
-20 to -36 dB
±3 dB

General Characteristics

OPERATOR INTERFACE
The instrument is controlled via a keyboard containing a data entry keypad. The 24 line 42 character (plus graphics capability) LCD and keyboard are fully interactive providing menu and soft-key operation.

SET UP
Copy facility from Transmitter to Receiver and Receiver to Transmitter.

DISPLAYS
Transmit parameters
Receive parameters
Measurement results
RS-232C port parameters
Printer type selection
Measurement definition
Autoprint definition
Setup conditions (Stored Parameters)
Current status

Zoom
Selected results can be displayed in zoom mode with large character size.

AUDIBLE ALARM

Mode
When on alarm sounds on detection of:
A signal alarm.
An errored second.

LOUDSPEAKER
Selected 64 kbit/s channels can be routed to the loudspeaker. There is a volume control.

SETUP CONDITIONS (STORAGE FACILITY)
A variety of information can be stored in non-volatile memory (battery backed-up).

Setup Conditions
6 sets of transmitter/receiver/test definition parameters can be selected for storage. Each set can be recalled whenever required, and can be identified with a 12 character label. In addition 13 non-alterable standard setups are available:
Unframed Transmitter and Receiver
30 Channel n × 64 kbit/s
31 Channel n × 64 kbit/s
30 Channel n × 64 kbit/s with CRC4.
31 Channel n × 64 kbit/s with CRC4.
30 Channel n × 64 kbit/s, Drop and Insert
31 Channel n × 64 kbit/s, Drop and Insert
30 Channel n × 64 kbit/s with CRC4, Drop and Insert
31 Channel n × 64 kbit/s with CRC4, Drop and Insert
30 Channel Monitor Live Traffic.
31 Channel Monitor Live Traffic.
30 Channel with CRC4 Monitor Live Traffic.
31 Channel with CRC4 Monitor Live Traffic.

REAL TIME CLOCK
Displays date and time.

Resolution
One second

Accuracy
±1 minute per week.

KEYBOARD LOCKOUT
The keyboard can be disabled whilst a test is running.

PRINTER OPERATION
The RS-232 port is used for printer operations and remote control

Printers
40 column minimum, RS-232 interface

Page Printing
Page printouts are initiated by the PRINT key and cause the whole of the current page to be printed. Graphics display pages can be printed in a text equivalent or a facsimile to a suitable printer.

Autoprinting
The printer can be set to print automatically on the occurrence of any of the following (where applicable), each event printed with its date and time and two digit identity number. A twelve character label is also printed where appropriate:
Test start and stop.
Loss and restoration of signal.
Loss and restoration of alignment.
Loss and restoration of pattern sync.
Detection of errors (ES).
Detection of alarms.
Detection of octet slips.
Detection of short term (current) error ratio, for the selected major error type, crossing a user set threshold.
Detection of change of signaling code.
Cumulative printout at user selectable intervals, with a resolution of 15 minutes.
All stored results may be included in the interval print.
User selectable.
Loss and restoration of power.

REMOTE CONTROL
The RS-232 port is used for Remote configuration and collection of results.

RS-232 PORT
The RS-232 port is used for printer operations and remote control.

Type
Asynchronous
DTE
Full Duplex

Bit Rates
300, 600, 1200, 2400, 4800 and 9600 bit/s.

Code
ASCII

Code bits. Parity/Stop bits
7/Odd/1, 7 /Even/1, 7/Odd/2, 7/Even/2, 8/None/1, 8/None/2

Terminator
None, CR, LF, CR \ LF.

Handshake
Hardware
DTR, RTS, CTS and DSR.
Software
XON and XOFF.

Lines used

Tx DATA	Pin 3
RTS	Pin 7
DTR	Pin 4
Rx DATA	Pin 2
CTS	Pin 8
DSR	Pin 6
Signal Ground	Pin 5

Connector
9 way female D-type

Electrical
To RS-232C / V.28

DISPLAY LANGUAGES
English, French

LIMIT RANGE OF OPERATION

Temperature
0 to 55°C (Display specified to 50°C)

Safety
Complies with IEC 1010-1, BS EN61010-1 for class 3 hand-held equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 supply.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
-40 to +70°C

Humidity
Up to 90% relative humidity (non condensing)

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential)

ELECTROMAGNETIC COMPATIBILITY
Conforms to the protection requirements of Council Directive 89/336/EEC.
Complies with the limits specified in the following standards.
BS EN55011 Class B CISPR 11.
BS EN55082-1.
IEC 801-2, 3, 4.

POWER REQUIREMENTS
The instrument is powered by internal batteries which give a nominal 5 hours operation. This is extended in receive only mode.

UNIVERSAL AC POWER ADAPTOR
The AC power adapter is capable of powering the instrument and at the same time recharging the batteries in 3 hours.

AC Voltage
90 to 264 V.

Frequency
45 to 440 Hz

Consumption
20 VA maximum.

DIMENSIONS AND WEIGHT

	Height	*Width*	*Depth*	*Weight*
2841	77 mm	206 mm	170 mm	1.5 kg
2840A	57mm	206mm	170mm	1.3kg

Versions and Accessories

When ordering please quote full ordering number information.

Ordering Numbers	*Versions*
2841	Digital Communications Analyzer.
2840A	2Mbit/s Transmission Analyzer.
	Options
Option 01	1.6/5.6 connectors.
Option 02	French key panel, C-Bit frame.
Option 04	Analog generation and measurement (2840A only - standard on 2841).
	Supplied Accessories
46882/290	Operating Manual 2841.
46882/227	Operating Manual 2840A.
46662/560	Universal AC Power Adapter (90 - 264V).
46662/561	Carrying Pouch. One adaptor lead from the list below selected at time of order (2841).
	Adaptor Leads (2841)
	One specified lead supplied at no charge. Additional leads can be ordered from the list below.
54311/190	X.21 (V.11) Adaptor Lead, 0.2m, female.
54311/191	RS-449 (V.11) Adaptor Lead, 0.2m, female.
54311/192	V.35 Adaptor Lead, 0.2m, female
54311/193	RS-232 Adaptor Lead, 0.2m, female.
54311/194	Co/Contradirectional Adaptor Lead - 15 way D-Type, 0.2m, female
54311/209	Codirectional Adaptor Lead - CF connectors, 0.2m, male.
54311/211	X.21 (V.11) Adaptor Lead, 2m, male.
54311/212	RS-449 (V.11) Adaptor Lead, 2m, male.
54311/213	V.35 Adaptor Lead, 2m, male.
54311/214	RS-232 Adaptor Lead, 2m, male.
54311/215	Co/Contradirectional Adaptor Lead - 15 way D-Type, 2m, male.
	Optional Accessories
46880/075	Service Manual.
54311/190	X.21 (V.11) Adaptor Lead, 0.2m, female (2841).
54311/191	RS-449 (V.36) Adaptor Lead, 0.2m, female (2841).
54311/192	V.35 Adaptor Lead, 0.2m, female (2841).
54311/193	RS-232 Adaptor Lead, 0.2m, female (2841).
54311/194	Co/Contradirectional Adaptor Lead - 15 way D-Type, 0.2m, female (2841).
54311/209	Codirectional Adaptor Lead - CF connectors, 0.2m, female (2841).
54311/211	X.21 (V.11) Adaptor Lead, 2m, male (2841).
54311/212	RS-449 (V.11) Adaptor Lead, 2m, male (2841).
54311/213	V.35 Adaptor Lead, 2m, male (2841).
54311/214	RS-232 Adaptor Lead, 2m, male (2841).
54311/215	Co/Contradirectional Adaptor Lead - 15 way D-Type, 2m, male (2841).
54311/121	RS-232 Lead - male to male - 25 Way D-Type - 1.5m (2841).
54311/122	X.21 Lead - male to male - 15 way D-Type - 1.5m (2841).
54311/147	RS-449 Lead - male to male - 37 way D-Type - 1.5 m (2841).
54311/148	V.35 Lead - male to male - 34 Way MRAC - 1.5 m (2841).
54311/130	Co/Contradirectional Test Lead - 15 way D-Type to free end (2841).
46662/562	Hard Carrying Case.
54717/039	Scriptos printer.
54311/217	RS-232 special lead Scriptos to 2841.
46662/620	Scriptos paper 10 packs.
46883/805	Signal lead balanced (CF-CF).
54311/210	Signal lead unbalanced (BNC-BNC).
46662/387	Null Modem (female to male).
46662/388	BNC to 1.6/5.6 adaptor.
46662/564	RS-232 adaptor - 9 way male to 25 way female D-Type.

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